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March 15, 2011

Mr. Harinder Singh and Mr. Ken Rider
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814-5512

Subject: Draft Staff Report Comments Regarding Stationary Applications

Harinder and Ken:

We have completed our analysis of the dual power supply architecture for stationary/reserve applications that you proposed during our meeting on March 3, 2011 as a potential solution to the efficiency, power factor, and maintenance power issues associated with battery chargers that are designed both to charge large stationary battery sets after they have been discharged during a period of time when AC power is not available and to continuously float charge these same battery sets at low DC current levels in order both to ensure that they are fully charged when needed and to ensure that they achieve their rated life spans.

The included document titled *Docket Number 09-AAER-2, Draft Staff Report Comments, Stationary Applications, Block Diagram, Lester Electrical, 3-15-2011.pdf* is a block diagram showing a Lester Electrical design of a stationary SCR battery charger with a “larger” transformer and SCRs sized to charge a stationary battery set after it has been discharged during a period of time when AC power is not available and a “smaller” transformer and SCRs sized to continuously float charge this same battery set at low DC current levels. Control power is provided by a secondary winding on the smaller transformer, and the controller controls a relay that can be used to remove AC power from the larger transformer.

Our analysis of this design has generated the following comments and issues, both technical and practical.

1. For many stationary applications, the battery charger is the primary DC power source in the system, and the battery set is only used in

emergencies when AC power is lost. Thus, the battery charger output is most often dictated by the DC load of the system, which lies somewhere between the maximum current required to charge the battery set after AC power has been lost and the minimum current required to float the battery set when fully charged. Moreover, the DC load of the system is dynamic, which results in the battery charger output continuously changing.

2. Because the output of the battery charger is required to quickly respond to the varying DC load of the system, the additional time required to make the decision in the controller to switch from the smaller transformer and SCRs and, of more concern, the switching time of the relay that applies AC power to the larger transformer and SCRs (around 10 ms) is a concern. For example, in a railroad application, the DC load at a railroad crossing could be below the switch-over point when the crossing is sitting idle, but as soon as a train approaches, the DC load instantly increases a significant amount with the operation of the crossing arms and signals. Any increase in switch-over time by the battery charger will result in the battery set discharging to supply the load. Stationary battery sets are only able to achieve their life span ratings (often 20+ years) if they are only discharged in emergencies when AC power is lost.

3. Battery chargers for stationary applications are designed for reliability, durability, and longevity, with expectations matching those of the batteries (often 20+ years). Our designs include no moving parts (with the exception of alarm relays), and our highest reliability designs employ analog control circuitry. We are concerned that the additional smaller transformer and SCRs and, of more concern, the electromechanical relay to remove AC power from the larger transformer will reduce reliability.

4. Our concern with the addition of an electromechanical relay is magnified by the potential of applications where the DC load of the system resides near the switch-over current, which could result in the battery charger switching back and forth between the larger transformer and SCRs and the smaller transformer and SCRs as the load varies only slightly. This could result in operating the electromechanical relay much more often than intended in the battery charger design and, thus, reduced reliability. Hysteresis could be used to combat this issue, but would not eliminate it.

5. Most of the stationary battery chargers that we produce include temperature compensation, which adjusts the float voltage based upon the temperature of the battery set. Our temperature compensation uses a temperature reference of 77°F (25°C), a voltage reference of 2.23 volts,

and a compensation value of 3.0 mV per °F. The equivalent equation for the compensated voltage is Vcomp = V – k (t - 77°F), where V is the voltage of the battery at 77°F, t is the temperature in °F, and k = V (.003 / 2.23). The temperature compensation range is between 32°F and 95°F (0°C and 35°C). Thus, we are required to design transformers with overhead to support temperature compensation, which reduces their efficiency and power factor and increases their maintenance power during operation below 95°F. This design requirement would apply to both the larger and smaller transformer in the proposed dual power supply architecture.

6. Our stationary battery chargers are designed to be capable of being used with multiple battery voltages and chemistries, and, in some cases, they are designed to be capable of being used with different battery capacities. As such, a practical concern is the selection of the switch-over current. In order to maximize efficiency and power factor and minimize maintenance power, we would need specific hardware designs for each and every battery voltage, chemistry, and capacity that are designed around a specific switch-over current. With over 50 stationary battery charger models, we do not feel that this is practical from a design perspective by us or a testing and validation perspective by our customers.

7. The addition of the smaller transformer, smaller SCRs, electromechanical relay, and accompanying wiring will require the battery chargers to grow in size. This will be an issue for many applications since space is at a premium. An example is a railroad switch, where the enclosures are designed to house little more than the existing battery charger, battery set, and monitoring/communication equipment.

8. Though the proposed dual power supply architecture would improve efficiency and power factor and reduce maintenance power, the output of the battery charger during float is still detrimental to stationary battery chargers achieving the 24-hour AC energy requirement since it is wasted energy according to the proposed equation.

Please feel free to contact me with any questions regarding this analysis.

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Best Regards,

Spencer Stock
Product Marketing Manager

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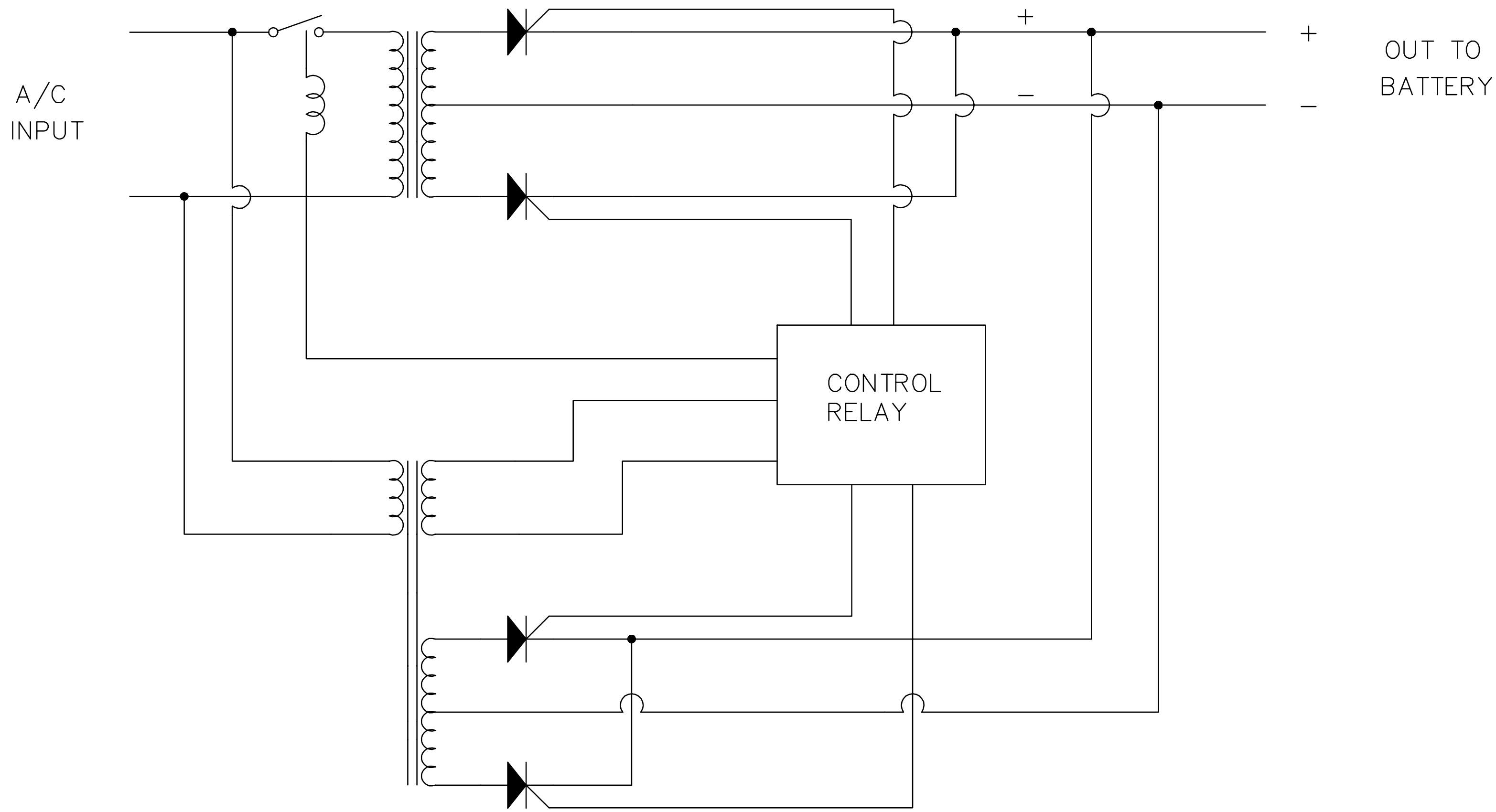
–	11/3/2011	–	CREATE DWG.	CLR	



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DECIMAL: ±.031	DESIGNED BY	SCALE NONE	DRAWN BY CLR	
FRACTIONAL: ±1/32	TITLE			
ANGULAR: ±1°				
SHEET 1 OF 1	DATE 11/3/2011	DRAWING NUMBER XXXXX		REV. –